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State Government E-Procurement: A Simulation Evaluation

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ABSTRACT

Electronic procurement can provide great efficiencies to governmental agencies. This paper reports a real case in a small Midwestern state where an old purchase order process was replaced with a much more efficient electronic procurement system. Interviews with the manager in charge enabled modeling the old and new processes with a simulation model, which produced output that was verified as accurate by subsequent discussion with state agency personnel. The simulation model is presented here to demonstrate how simulation tools can support e-procurement analysis.

Keywords

E-procurement, simulation, business process reengineering.

INTRODUCTION

Public sector organizations have a well-deserved reputation for inefficient and costly procurement policies (Edmiston, 2003). As a direct result, policymakers have recently experienced increased pressure to reduce costs and promote efficiency within their procurement processes (Seifert and Peterson, 2002). Robb (2000) claims that although 80 percent of all government agency purchases involve less than \$500, agencies spend between \$120 and \$150 to process a paper-based purchase order. Without question, this represents a very significant cost per transaction. For example, the State of Massachusetts reportedly reduced its procurement cost from an average of \$110 per paper-based transaction (notably already below the figure presented above) to \$10 for an average Internet-based procurement transaction (Robb, 2000). Online procurement, known as e-procurement, appears to have a significant potential for reducing costs while enhancing efficiency and it is anticipated that 42 states will have electronic procurement processes in place by the end of 2003 (Terry, 2001).

The purpose of this study is to explore, with simulation techniques, the potential cost impact associated with the adoption of an e-procurement system across governmental agencies in a small, geographically dispersed state. While several practitioner oriented studies (i.e. Robb, 2000; Seifert and Peterson, 2002; Terry, 2001) consider and describe the costs and benefits of e-procurement in a for-profit environment, this research area lacks a rigorous academic investigation involving a governmental entity. Our assessment is focused on the labor cost savings that could be expected to accompany such a technology-enabled procurement process. Anticipated time savings provide the basis for estimating labor cost savings. The data is based upon a real case. Simulation models are presented to demonstrate how simulation could be applied to this decision domain. The actual decision was made without use of the simulation, although the simulation results were verified with state officials as being accurate.

BACKGROUND AND LITERATURE REVIEW

E-procurement initiatives can and often do present substantial challenges to government administrators for at least two substantive reasons. First, many public sector agencies were created, and their general procurement processes were put in place, long before the advent of client/server computing and internet technology (McIver, *et al.*, 2002).

Over the past decade many organizations within the private sector have realized that to achieve successful, technology-enabled change and thereby realize the associated benefits, such as those ascribed to the adoption of e-procurement, their operational environments must be reengineered towards a process orientation. Reengineering is defined as the “fundamental revision and radical redesign of processes to reach spectacular improvements in critical and contemporary measurements of efficiency, such as costs, quality, service, and quickness” (Hammer and Champy, 1993, p.19). While a traditional government organization (bureaucracy) is structured around functional departments such as Accounting, Payroll, Logistics, Procurement, etc. (silos), a process-centered organization is designed and deployed around reoccurring cross-functional chains of activities that add value to an organization’s activities. Hammer & Stanton (1999) assert that over the past decade reengineering initiatives in the private sector have allowed organizations to function more efficiently and use information technology more productively. These initiatives have been widely credited with improving the jobs of employees, giving

them more authority, and presenting a clearer view of how their work fits into the operations of the enterprise as a whole—all positive attributes that would surely be applicable to public sector employees.

The primary motivating factor for most private sector organizations is the desire for profit, an influence that does not exist within the management decision framework of public sector organizations. Therefore, decision support techniques that focus primarily on profits may not be readily applicable to, or desirable to use in public sector decision-making. Further, and of great importance to public sector research, such organizations tend to be accountable to large numbers of stakeholders with diverse interests in the portfolio of projects and the accompanying evaluation processes. This unique combination adds exponentially to the level of complexity facing public sector managers. Hays and Bebbington (2000) conclude that “the operation of public systems is generally so complex that simulation is the only technique flexible and broad enough to effectively address all the relevant issues and to analyze the system” (Hays and Bebbington, 2000, p. 466). Further, several studies have indicated that simulation is an appropriate tool for process reengineering (i.e. Lee and Elcan, 1996; Paul *et al.*, 1999; Nissen, 1998; and Kettinger *et al.*, 1997). It appears, therefore, that simulation provides a method that is robust enough to address the issue of e-procurement in a government context.

Data Collection

The research subject for this study is the State of South Dakota procurement process.

Current Procurement Process

A description of the existing procurement process and some of its associated expenses was collected and confirmed through two sources. First, the Director of South Dakota’s Office of Procurement Management (SD-OPM), was interviewed. He provided an overview of the state’s procurement process during a structured phone interview. His depiction included the sequence of activities that currently constitute the process, time required to complete each step of the process, percentage of purchases below \$1000, individual(s) who complete each activity within the process, average labor cost for each individual involved in the process, and associated postage costs for each purchase request. Second, the State of SD’s procurement manual was obtained and reviewed as a means to validate and confirm the Director’s description of the processing activities. No differences were identified between the Director’s depiction of the process and that provided within the documentation of the procurement manual. Figure 1 displays the current steps of this process, conducted by two groups of clerks supporting a manager whose approval is required for purchase orders exceeding \$1,000.

Proposed E-Procurement Process

In a second interview, the Director of the SD-OPM was asked to describe his conceptualization for an e-procurement environment. As the state is currently considering such a system, and in fact a vendor (Public Buy) has provided responses to an initial Request for Information (RFI), his rendition was considered a solid reflection of the environment that would likely accompany actual implementation of e-procurement in SD. The Director provided a copy of the relevant portions of the RFI response to support this study. In combination, the interview and the vendor’s responses were deemed sufficient to permit an accurate identification and specification of activities, activity times, and labor costs for an e-procurement system. This proposed system is displayed in Figure 2.

Data Analysis

A simulation model was developed for both systems.

Current Procurement Process

The SD current procurement process, as detailed above, was documented and analyzed using Process Model release 4.0 a simulation tool. The existing process was modeled as shown in Figure 1, with each activity assigned a normally distributed duration. Agency staff members were responsible to gather three quotations, and submit the lowest quote to the agency manager. If the lowest quotation was \$1,000 or less, it was sent on to PM staff for processing, to include a verification of regulatory requirements. If the low quotation exceeded \$1,000, the agency manager decided upon approval, and the purchase order was further processed.

Figure 1: Current Process

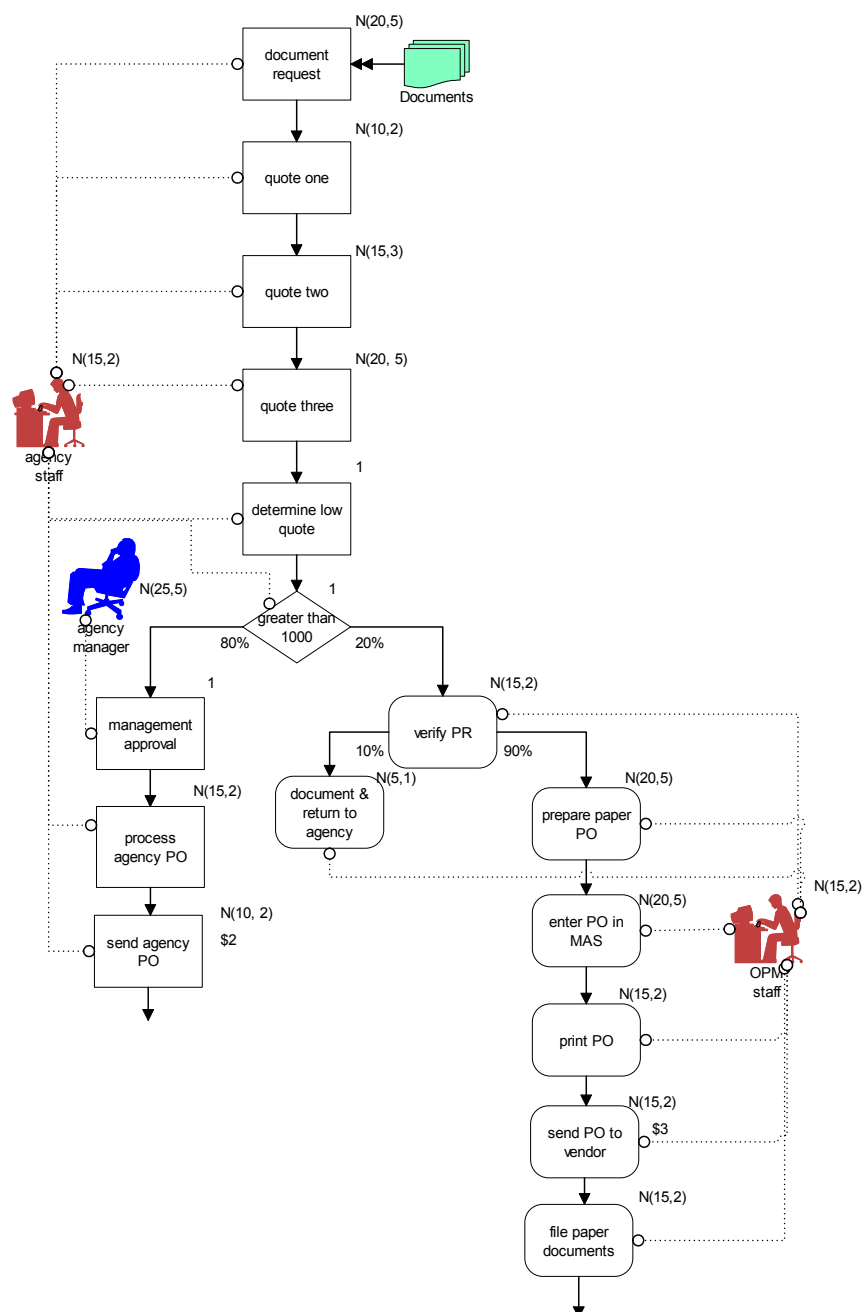
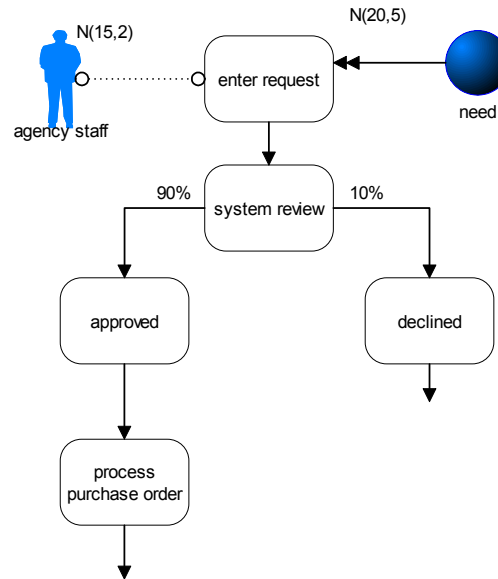


Figure 2: Proposed State Agency Process

The simulation model elements and parameters for the current procurement process as displayed in Figure 1 are described in Table 1.

Table 1: Current Model Simulation Elements**INCOMING PURCHASE ORDER REQUESTS**

Node	Function	Distribution	Mean	Variance	Resource
Documents	Arriving work	Normal	20 minutes	5 minutes	
Document request		Normal	5 minutes	2 minutes	Agency staff (4)
Obtain first quote		Normal	10 minutes	2 minutes	Agency staff (4)
Obtain second quote		Normal	15 minutes	3 minutes	Agency staff (4)
Obtain third quote		Normal	20 minutes	5 minutes	Agency staff (4)
Identify low quote		constant	1 minute		Agency staff (4)
Over 1000?	Check	constant	1 minute		1

IF < \$1000

Node	Function	Distribution	Mean	Variance	Resource
Management approval	Arriving work	Normal	25 minutes	5 minutes	Agency manager (1)
Process agency PO		Normal	15 minutes	2 minutes	
Send agency PO		Normal	10 minutes	2 minutes	

IF \$1000 OR MORE

Node	Function	Distribution	Mean	Variance	Resource
PR verified?	Check	Normal	15 minutes	2 minutes	
Document & return to agency	NO 10 percent	Normal	5 minutes	1 minute	
Prepare paper PO	YES 90 percent	Normal	20 minutes	5 minutes	PM Staff (2)
Enter PO in MAS		Normal	20 minutes	5 minutes	PM Staff (2)
Print PO		Normal	15 minutes	2 minutes	PM Staff (2)
Send PO to vendor		Normal	10 minutes	2 minutes	PM Staff (2)
File paper documents		Normal	15 minutes	2 minutes	PM Staff (2)

The results for this model for 100 replications over 1,750 hours of operation (one working year) for this model found an average of 5,167 purchase orders processed, with an average cycle time (time in the system) of 947 minutes (or about 15 hours), including 109 minutes on average of actual working time. The average cost of assigned workers was \$25.27 per purchase order processed.

Electronic Procurement Process

The simulation model for the proposed automated procurement process was much simpler. It is shown in Figure 2 with the model elements and parameters given in Table 2.

Table 2: Proposed State Agency Process Model Simulation Elements

Node	Function	Distribution	Mean	Variance	Resource
Documents	Arriving work	Normal	20 minutes	5 minutes	
Document request		Normal	15 minutes	2 minutes	Agency staff (2)
PR verified?	Check verification	Constant	1 minute		
Declined	NO (10 percent)	Constant	1 minute		
Process PO	YES (90 percent)	Normal	8 minutes	2 minutes	Agency staff (2)

This model was also run 100 times over a 1,750 hour working year. The models were built within the software Process Model 4, in a matter of less than an hour. Each activity had its own distribution for duration, and percentage routing was entered in the windows provided by the software. Each model was run 100 times facing equivalent loads over a simulated year of 1,750 hours of operation per run. The software provided counts and average minutes per activity, but it also provided key output of interest directly, with mean and standard deviation. Output from the simulation provides means and standard deviations, which can be utilized to conduct the traditional comparisons for significance testing. In this case, it is obvious that the electronic procurement system is far superior to the pre-existing manual system. Table 3 provides system output.

Table 3: Simulation Model Output

		Pre-existing System	E-Procurement System
Value added time per case	Mean	109.56 min.	22.19 min.
	Standard deviation	0.26 min.	0.04 min.
Labor cost per case	Mean	\$25.27	\$4.06
	Standard deviation	\$0.06	\$0.00

Clearly the E-Procurement system has an overwhelming time and cost advantage over the Pre-existing system in this case. In general, the simulation output could help identify the relative advantage in quantitative terms for cases with less obvious results. The results of the simulation analysis indicate state employees spend 109.56 minutes to process each purchase request received. Additionally, the state spends \$25.27 in labor cost and postage to process each purchase request received. These results were validated by the Director of the SD-OPM.

The results of the proposed e-procurement process simulation analysis indicate state employees would spend approximately 22.19 minutes to process each purchase request received. Additionally, the state would spend approximately \$4.06 in labor cost to process each purchase request received.

The results of this exploratory case study indicate the state of SD would enjoy significant reduction in the labor time required to process each purchase request. This conclusion was verified by the real decision maker. An e-procurement system would eliminate duplication of efforts and reduce the need for management review of each purchase request. Additionally, an e-procurement system will lead to a reduction in postage cost since purchase orders will be electronically sent to vendors.

CONCLUSIONS

Government agencies worldwide are seeking to reform their operations by applying business practices to the operation of government processes. From an economic and normative perspective this movement appears to be a logical and rational approach to improving government processes. However, it is without sufficient foundation to merely assume that public sector organizations will seek to operate like their private sector counterparts for good and sufficient reasons. Claims of increased effectiveness and efficiency attributed to these “best practices” operational movements must be empirically validated through the rigors of academic research.

This study focused on the labor cost savings resulting from e-procurement. As would be normatively anticipated the results of the simulation analysis indicate that the implementation of an e-procurement system would result in significant cost savings for the state. From the perspective of management (i.e. the state CIO), adoption of an e-procurement system would likely be a success story. However, information system success is a multifaceted concept. Future research is required to investigate the impact of state e-procurement systems from the perspective of end-users.

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